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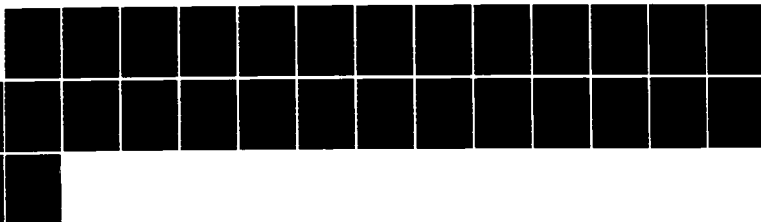
RDF (REFUSE-DERIVED FUEL) CO-FIRING COST/BENEFIT
ANALYSIS USING THE NCEL R. (U) SYSTECH CORP XENIA OH
H BELECAN ET AL. AUG 86 NCEL-CR-86.012-VOL-3
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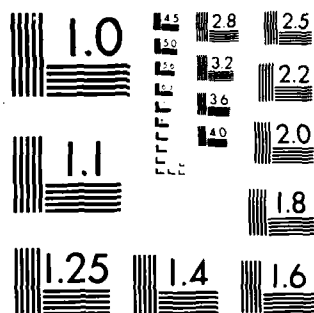
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

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NCEL

Contract Report

CR 86 012

August 1986

An Investigation Conducted
By SYSTECH Corporation

Sponsored By Naval Facilities
Engineering Command

AD-A173 982

FINAL REPORT: RDF CO-FIRING COST/BENEFIT ANALYSIS USING THE NCEL RDF COST MODEL VOLUME III, RDF COST MODEL MANUAL

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ABSTRACT The object of this effort was to determine the cost effectiveness of co-firing RDF in existing Navy boilers. The cost benefit analysis was performed using the NCEL RDF Cost Model and site specific boiler and cost data acquired from four naval activities that were determined to have the highest probability of successful co-firing. The cost effectiveness was measured by the savings to investment ratio (SIR) and computed over a range of cost and operating conditions to determine optimum RDF co-firing scenarios for each facility. Based on present laid-down coal costs and solid waste disposal charges, no set of operating conditions could be identified wherein the use of either co-fired RDF 3 or RDF 5 could be economically justified. Volume I presents the report; Volume II contains appendixes, and Volume III is the terminal manual of RDF cost model.

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TABLE OF CONTENTS

Figures	iv
Tables	v
<u>Section</u>	<u>Page</u>
1.0 Introduction	1
2.0 Hardware Requirements	1
3.0 Program Disk Contents	1
4.0 Before Starting - Copying the Program	2
4.1 Multiplan® Program Notes	2
4.2 Hard Disk Systems	2
4.3 Floppy Disk Systems	2
5.0 Running the Model	3
5.1 Booting and Loading the Input Data Sheet (RDFMDLIN)	3
5.2 Changing Data Values	3
5.3 Saving RDFMDLIN	4
5.4 Executing the Calculations	4
5.5 Printing the Results	4
6.0 Exiting the Program	6

FIGURES

<u>Number</u>		<u>Page</u>
4.1	Dependency Diagram	2
5.1	Multiplan® Opening Screen	7
5.2	Transfer Command Line	8
5.3	Transfer Load Command Line	9
5.4	File Name Selection Using the Directory	10
5.5	RDFMDLIN	11
5.6	Transfer/Save Command	12
5.7	Transfer/Save Options	13
5.8	Edit Line	14
5.9	Main Print Command Line	15
5.10	Print Margins	16
5.11	Print Options	17

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TABLES

<u>Number</u>		<u>Page</u>
3.1	RDF Cost Model Program Disk Directory	1
5.1	Standard Page Margins (8 1/2 x 11)	6
5.2	Wide Page Margins (11 X 14)	6

SECTION 1.0 INTRODUCTION

The NCEL RDF Cost Model is based on the Microsoft Multiplan® Spread Sheet Program, and is IBM PC compatible. The instructions presented here are intended to provide the information required to effectively use the model, and do not attempt to include all the specifics involved with using Multiplan®. For more detail on Multiplan®, refer to the Multiplan® User Manual. For further information about the model itself, the user is referred to Volume I of "RDF Co-Firing Cost/Benefit Analysis Using the NCEL RDF Cost Model."

2.0 HARDWARE REQUIREMENTS

The model is designed for the IBM PC (or compatible) with the following basic configuration:

- A. Disk operating system.
- B. 64 K bytes of memory.
- C. One floppy disk drive.
- D. Text printer capable of 132 characters per line.

3.0 PROGRAM DISK CONTENTS

The program disk contains 14 files. These include six Multiplan® Program files and eight RDF Cost Model files (referred to as "sheets"). Table 3.1 lists these file names and their functions.

TABLE 3.1. RDF COST MODEL PROGRAM DISK DIRECTORY

File name	Function
MP.LOD	Multiplan® system file
MP.SYS	Multiplan® system file
MP40.DAT	Multiplan® system file
MP.HLP	Multiplan® system file
MP80.DAT	Multiplan® system file
MP.COM	Multiplan® system file
RDFMDLIN	Input data sheet
WORK1	Calculates preliminary values
WORK2	Calculates final values
OUT1	Prints out intermediate data
OUT2	Prints out intermediate data
OUT3	Prints out intermediate data
OUT4	Prints out final operational and economic data

4.0 BEFORE STARTING - COPYING THE PROGRAM

4.1 Multiplan® Program Notes

As a memory conservation technique, Multiplan® uses a spread sheet linking function, called External Copy, to transfer data from one sheet to another. Once established, this External Copy is dependent on both a named range of values and the name of the sheet in which these values originally reside. For example, the data input to the RDFMDLIN sheet is stored in the range RDFMDLIN.XFERDATA. Using the External Copy function, Multiplan® transfers those values (which are stored in RDFMDLIN.XFERDATA) to WORK1. WORK1 then uses those transferred values to perform preliminary calculations. This inherent dependency, as illustrated in Figure 4.1, places the requirement that the file name remains unchanged. If the file names are changed, the External Copy function will not work. Therefore, to save data on various facilities or various data sets on the same facility, the sheets (along with the program files) must be saved under the original file names on separate disks or in separate directories.

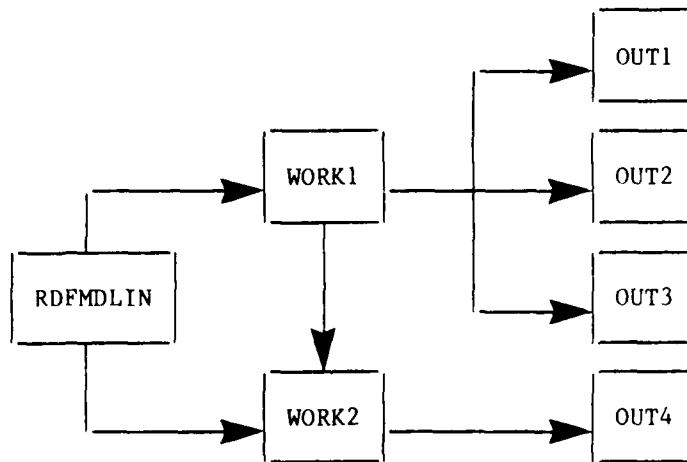


Figure 4.1. Dependency diagram.

4.2 Hard Disk Systems

Create a directory using the appropriate DOS command and copy the contents of the program disk to the new directory. Store the original program disk and use the hard disk copy exclusively. The hard disk will significantly increase the operating speed of the program, especially the External Copy and recalculation functions. It is recommended that individual directories or sub-directories be created to maintain individual data sets.

4.3 Floppy Disk Systems

Using the appropriate DOS command, copy the contents of the program disk to a working disk. If individual data sets are to be maintained, a separate disk should be used for each.

5.0 RUNNING THE MODEL

5.1 Bootng and Loading the Input Data Sheet (RDFMDLIN)

- A. Boot the computer using the DOS.
- B. Insert the working program disk in Drive A or change directories to the one containing the program.
- C. At the system prompt (A> or C>), type MP, depress ENTER.
- D. Figure 5.1 illustrates the opening screen. From the COMMAND line, select Transfer by either:
 1. Typing T, or
 2. By moving the cursor with the TAB key and then depressing ENTER.
 3. If an incorrect letter is typed or if an undesired menu selection is made, use the ESC key to return to the previous menu.
- E. The COMMAND line will then change, as illustrated in Figure 5.2 Select Load by typing L or moving the cursor as described in Step 4 above.
- F. As illustrated in Figure 5.3, a file name is requested. Enter RDFMDLIN by either:
 1. Typing RDFMDLIN and depressing ENTER, or
 2. Viewing the directory by depressing any of the cursor movement keys, and then selecting the file name RDFMDLIN by moving the cursor and depressing ENTER. Figure 5.4 illustrates the directory screen.
- G. RDFMDLIN is now the current sheet. Figure 5.5 illustrates how it appears on the computer screen.

5.2 Changing Data Values

At this point, changes to the existing values should be input. To do this:

- A. Move the cursor to the appropriate cell with the cursor movement keys.
- B. Type in the correct value, depress ENTER.

5.3 Saving RDFMDLIN

When all the desired values are input, save RDFMDLIN. From the COMMAND line, select:

- A. Transfer, Save (Type "T", then "S").
- B. The name of the current sheet, which appears in the lower right corner of the screen, will automatically appear as the file name under which new data will be saved (see Figures 5.6 and 5.7). As discussed above, do not change the file name. When prompted "Overwrite existing file?", type "Y" for yes. A No ("N") response will return you to the main command line. If it is necessary to save the new RDFMDLIN on a different disk drive or a different directory, type in the full path name; i.e., B:\RDFMDLIN or C:\MPI\RDFMDLIN, etc.

5.4 Executing the Calculations

To execute the calculations of the model with the newly input values, it is only necessary to Load and Save files WORK1 and WORK2 as follows:

- A. Transfer, Load WORK 1 (as described in Section 5.1, Step 5).
- B. Transfer, Save WORK1 (following the procedures described in Section 5.3).
- C. Transfer, Load WORK2.
- D. Transfer, Save WORK2.

5.5 Printing the Results

At this point, any of the sheets that are used to obtain printouts of the data can be loaded and printed. The following describes how to load and print any of the OUT sheets (1, 2, 3, or 4). OUT4 will be the most frequently used sheet as this sheet presents final co-fire and non co-fire operational and economic data. Therefore, it will be used for this example:

- A. After having Loaded and Saved both WORK1 and WORK2, Transfer - Load OUT4 (or the desired OUT sheet).
- B. To add a descriptive title line:
 - 1. Depress the Home key.
 - 2. Select Edit from the COMMAND line.
 - 3. Use the backspace (←) key to erase the current contents.

4. Type in the desired text - it will appear in the edit line (Figure 5.8).
 5. End text with double quotes ("), depress ENTER.
- C. From the COMMAND line, select Print (type "P").
- D. Figure 5.9 illustrated the main Print commands.
1. Select MARGINS and set as described in Table 5.1 for standard or Table 5.2 for wide page (also see Figure 5.10).
 2. Use the TAB key to move the cursor to each selection. Type in the desired value, then tab to the next setting. Do not depress ENTER until the setting changes are complete. Depressing ENTER will return you to the main Print Command line.
 3. From the main Print Command line, select OPTIONS (Figure 5.11), then Area. This defines what will be printed. It can be the entire sheet or a portion of the sheet. To select an Area:
 - a. Use the DEL key to clear the current setting.
 - b. The Area to be printed is defined by the top left cell and the bottom right cell.
 - c. To define the Area either:
 - (1) Enter the cell locations by directly typing them in; i.e., R1C1:R10C10. This represents the 10 rows between Columns 1 and 10, inclusive, or;
 - (2) Point to the cells. To do this:
 - (a) Depress the HOME key.
 - (b) Move the cursor to the desired top left cell using the cursor movement keys.
 - (c) Depress the colon (:) key.
 - (d) Move the cursor to the bottom right corner cell.
 - (e) Depress ENTER to complete the selection of the area to be printed and return to the main Print Command line.
 - (f) Align the paper in the printer and make any other printer adjustments as may be required.
 - (g) Type "P" to start printing. When printing is complete, the main Command line will appear.

TABLE 5.1. STANDARD PAGE MARGINS
(8 1/2 x 11)

Left:	0 to 5 characters
Top:	0 to 10 characters
Width:	70 to 80 characters
Print length:	54 lines
Page length:	66 lines

TABLE 5.2. WIDE PAGE MARGINS
(11 x 14)

Left:	0 to 5 characters
Top:	0 to 10 characters
Width:	136 characters (10 cpi) 240 characters (12 cpi)
Print length:	54 lines
Page length:	66 lines

E. Transfer, Save OUT4.

6.0 EXITING THE PROGRAM

- A. From the main command line, type "Q" for Quit.
- B. Type "Y" to confirm the Quit command.
- C. This returns you to the operating system.

#1	1	2	3	4	5	6	7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

COMMAND: Alpha Blank Copy Delete Edit Format Goto Help Insert Lock Move
 Name Options Print Quit Sort Transfer Value Window Xternal
 Select option or type command letter
 R1C1 100% Free Multiplan: TEMP

Figure 5.1. Multiplan® opening screen.

#1	1	2	3	4	5	6	7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

TRANSFER: Load Save Clear Delete Options Rename

Select option or type command letter

R1C1 100% Free Multiplan: TEMP

Figure 5.2. Transfer command line.

#1	1	2	3	4	5	6	7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

TRANSFER LOAD filename:

Enter a filename, or use direction keys to view directory

R1C1 100% Free Multiplan: TEMP

Figure 5.3. Transfer load command line.

MP.LOD
MP80.DAT
WORK1
OUT4

MP.SYS
MP.COM
OUT2
OUT5

MP40.DAT
OUT1
OUT3

MP.HLP
RDFMDLIN
WORK2

TRANSFER LOAD filename: RDFMDLIN

Enter a filename, or use direction keys to view directory

R1C1

100% Free

Multiplan: TEMP

Figure 5.4. File name selection using the directory.

```

#1      1      2      3      4      5      6      7
1      1 PORT HUENEME ALGORITHM. REVISED AND SIMPLIFIED 12/01/84
2      2                                MODIFIED JANUARY 1986
3      3 Facility:
4      4                                INPUTS(LINES 3 TO 105):
5      5 SUMMER STEAM DEMANDS:
6      6                                AVERAGE HOURLY BTU INPUT IN THESE MATRICES
7      7                                SHIFT 1    SHIFT 2    SHIFT 3
8      8                                MON-FRI    50000000  45000000  45000000
9      9                                SAT        40000000  40000000  40000000
10     10                                SUN        40000000  40000000  40000000
11     11 WINTER STEAM DEMANDS:
12     12                                AVERAGE HOURLY BTU STEAM
13     13                                SHIFT 1    SHIFT 2    SHIFT 3
14     14                                MON-FRI    150000000  140000000  135000000
15     15                                SAT        130000000  130000000  130000000
16     16                                SUN        130000000  130000000  130000000
17     17 SPRING AND FALL STEAM DEMANDS:
18     18                                AVERAGE HOURLY BTU
19     19                                SHIFT 1    SHIFT 2    SHIFT 3
20     20                                MON-FRI    100000000  92500000  90000000
COMMAND: Alpha Blank Copy Delete Edit Format Goto Help Insert Lock Move
          Name Options Print Quit Sort Transfer Value Window Xternal
Select option or type command letter
R8C5      50000000                                96% Free      Multiplan: rdfmdlin

```

Figure 5.5. RDFMDLIN.

#1	1	2	3	4	5	6	7
1	SUMMARY RESULTS BEGIN ON LINE 410: MODIFICATION 8: CHERRY POINT DAT						
2	407						
3	408	UNITS	RDF	CONVENTIONAL	VARIABLE		
4	409		COFIRING	FUEL	DEFINITION		
5	410	BTUH	6.84E+07	6.84E+07	ENTHALPY TRANSFERED		
6	411	BTUH	1.45E+08	1.41E+08	MCR, ABS MAX FOR COF		
7	412	BTUH	3.27E+07	NA	MAXIMUM TURNDOWN STE		
8	413	NONE	0.78	0.82	BOILER EFFICIENCY AT		
9	414	NONE	0.70	0.82	BOILER EFFICIENCY AT		
10	415	BTUH	1.50E+08	1.50E+08	MAXIMUM STEAM DEMAND		
11	416	NONE	0.00	NA	DERATE		
12	417	BTUH	9.81E+07	8.37E+07	TOTAL FUEL INPUT ENT		
13	418	TPH	3.11	NA	RDF FLOWRATE, AVERAG		
14	419	LB/HR	5605	7969	CONVENTIONAL FUEL IN		
15	420	LB/HR	1927	791	SOLID RESIDUE GENERA		
16	421	NONE	0.47	0.30	CARBON CONTENT OF SO		
17	422	NONE	2.31	0.37	FLYASH FRACTION OF S		
18	423	LB/HR	3	0	FLYASH EMISSION ABSO		
19	424	LB/MMBTU	0.02	0.00	EMISSION OF TSP, MAX		
20	425	LB/MMBTU	31.38	3.43	UNCONTROLLED FLYASH		

EDIT: "SUMMARY RESULTS BEGIN ON LINE 410: MODIFICATION 8: CHERRY POINT DATA

Enter a formula

R1C1 "SUMMARY RESULTS BEGIN ON LI 88% Free Multiplan: out4

Figure 5.8. Edit line.

#1	1	2	3	4	5	6	7
1	SUMMARY RESULTS BEGIN ON LINE 410: MODIFICATION 8: CHERRY POINT DAT						
2	407						
3	408	UNITS	RDF	CONVENTIONAL		VARIABLE	
4	409		COFIRING	FUEL		DEFINITION	
5	410	BTUH	6.84E+07	6.84E+07		ENTHALPY TRANSFERED	
6	411	BTUH	1.45E+08	1.41E+08		MCR, ABS MAX FOR COF	
7	412	BTUH	3.27E+07	NA		MAXIMUM TURNDOWN STE	
8	413	NONE	0.78	0.82		BOILER EFFICIENCY AT	
9	414	NONE	0.70	0.82		BOILER EFFICIENCY AT	
10	415	BTUH	1.50E+08	1.50E+08		MAXIMUM STEAM DEMAND	
11	416	NONE	0.00	NA		DERATE	
12	417	BTUH	9.81E+07	8.37E+07		TOTAL FUEL INPUT ENT	
13	418	TPH	3.11	NA		RDF FLOWRATE, AVERAG	
14	419	LB/HR	5605	7969		CONVENTIONAL FUEL IN	
15	420	LB/HR	1927	791		SOLID RESIDUE GENERA	
16	421	NONE	0.47	0.30		CARBON CONTENT OF SO	
17	422	NONE	2.31	0.37		FLYASH FRACTION OF S	
18	423	LB/HR	3	0		FLYASH EMISSION ABSO	
19	424	LB/MMBTU	0.02	0.00		EMISSION OF TSP, MAX	
20	425	LB/MMBTU	31.38	3.43		UNCONTROLLED FLYASH	

PRINT: Printer File Margins Options

Select option or type command letter

R1C2

88% Free

Multiplan: out4

Figure 5.9. Main print command line.

#1	1	2	3	4	5	6	7
1	SUMMARY RESULTS BEGIN ON LINE 410:						
2	407						
3	408 UNITS	RDF	CONVENTIONAL			VARIABLE	
4	409	COFIRING	FUEL			DEFINITION	
5	410 BTUH	6.84E+07	6.84E+07			ENTHALPY TRANSFERED	
6	411 BTUH	1.45E+08	1.41E+08			MCR, ABS MAX FOR COF	
7	412 BTUH	3.27E+07	NA			MAXIMUM TURNDOWN STE	
8	413 NONE	0.78	0.82			BOILER EFFICIENCY AT	
9	414 NONE	0.70	0.82			BOILER EFFICIENCY AT	
10	415 BTUH	1.50E+08	1.50E+08			MAXIMUM STEAM DEMAND	
11	416 NONE	0.00	NA			DERATE	
12	417 BTUH	9.81E+07	8.37E+07			TOTAL FUEL INPUT ENT	
13	418 TPH	3.11	NA			RDF FLOWRATE, AVERAG	
14	419 LB/HR	5605	7969			CONVENTIONAL FUEL IN	
15	420 LB/HR	1927	791			SOLID RESIDUE GENERA	
16	421 NONE	0.47	0.30			CARBON CONTENT OF SO	
17	422 NONE	2.31	0.37			FLYASH FRACTION OF S	
18	423 LB/HR	3	0			FLYASH EMISSION ABSO	
19	424 LB/MMBTU	0.02	0.00			EMISSION OF TSP, MAX	
20	425 LB/MMBTU	31.38	3.43			UNCONTROLLED FLYASH	
PRINT MARGINS: left: 5 top: 5 print width: 76 print length: 54							
page length: 66							
Enter a number							
R1C1	"SUMMARY RESULTS BEGIN ON LI			88% Free	Multiplan: out4		

Figure 5.10. Print margins.

#1	1	2	3	4	5	6	7
1	SUMMARY RESULTS BEGIN ON LINE 410:						
2	407						
3	408	UNITS	RDF	CONVENTIONAL		VARIABLE	
4	409		COFIRING	FUEL		DEFINITION	
5	410	BTUH	6.84E+07	6.84E+07		ENTHALPY TRANSFERED	
6	411	BTUH	1.45E+08	1.41E+08		MCR, ABS MAX FOR COF	
7	412	BTUH	3.27E+07	NA		MAXIMUM TURNDOWN STE	
8	413	NONE	0.78	0.82		BOILER EFFICIENCY AT	
9	414	NONE	0.70	0.82		BOILER EFFICIENCY AT	
10	415	BTUH	1.50E+08	1.50E+08		MAXIMUM STEAM DEMAND	
11	416	NONE	0.00	NA		DERATE	
12	417	BTUH	9.81E+07	8.37E+07		TOTAL FUEL INPUT ENT	
13	418	TPH	3.11	NA		RDF FLOWRATE, AVERAG	
14	419	LB/HR	5605	7969		CONVENTIONAL FUEL IN	
15	420	LB/HR	1927	791		SOLID RESIDUE GENERA	
16	421	NONE	0.47	0.30		CARBON CONTENT OF SO	
17	422	NONE	2.31	0.37		FLYASH FRACTION OF S	
18	423	LB/HR	3	0		FLYASH EMISSION ABSO	
19	424	LB/MMBTU	0.02	0.00		EMISSION OF TSP, MAX	
20	425	LB/MMBTU	31.38	3.43		UNCONTROLLED FLYASH	

PRINT OPTIONS: area: R1C4:5 setup:
formulas: Yes(No) row-col numbers: Yes(No)

Enter reference to cell or group of cells
R1C2 88% Free Multiplan: out4

Figure 5.11. Print options.

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